TRANSFERABILITY EXPERIMENTS USING TWO REGIONAL CLIMATE MODELS

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RESUMO Simulações climáticas regionais de dois modelos são examinadas sobre quatro regiões (Caribe, Leste Europeu, Andes Peruanos e Norte América) com o objetivo de avaliar sua transferibilidade. Os modelos utilizados são: versão climática do modelo ETA do CPTEC (ETACLIM) e a última versão RegCM3 do ICTP. Foram utilizadas como condições iniciais e de fronteira dados da reanálise II do NCEP/DOE. São discutidas análises preliminares dos campos médios mensais da precipitação para eventos de seca e enchentes (eventos extremos) sobre as regiões de estudo.

ABSTRACT Two Regional Climate Model (RCM) simulations are examined over four regions (Caribbean, East Europe, Peruvian Andes and US) with the objective of assessing their transferability. The models are: the CPTEC climate version of ETA model (ETACLIM) and the latest version of ICTP RegCM3. The initial and boundary conditions were taken from the NCEP/DOE reanalysis II data sets. Preliminary analysis of the monthly mean of precipitation field in different climatic regimes (extreme events: droughts and very rainy periods) are discussed.

Palavras-chave Transferibilidade, modelos regionais climáticos.

INTRODUCTION

The main objective of transferability experiments is to understand the physical processes associated to energy and water budget and their predictability through regional climate simulations on several domains. The use of RCM to simulate different climate regimes (e.g. tropical vs. middle latitudes) or different regions with common climate regimes (e.g. monsoons, low-level jets), without change in tuning parameters, provide a framework to evaluate the quality of parameterizations in non-native regions. Also the transferability issue is important when regional models are used to assess regional consequences of global climate change because the climate in the future may be different from that used for calibration with the present climate (Takle et al., 2006). The aim of this paper is to test the transferability of regional climate models used at CPTEC over different regions in extreme events periods (droughts and very rainy periods).

METODOLOGY

Descriptions of the models

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The ETACLIM model is a climate version of the ETA model implemented at CPTEC by Fernandez et al. (2006) and Tarasova et al. (2006). The RegCM3 model (Pal et al., 2006), used in this paper, is an improved version of the RegCM2 (Giorgi et al., 1993a, b). Both are hydrostatic limited area models, with finite-difference discretization. They use sigma and eta coordinates in the vertical, respectively. The main characteristics of these models are described in Fernandez et al. (2006). These models will be used in these simulations; both were applied in different studies and were set up for specific regions (Fernandez et al., 2006; Martinez et al., 2006).

Data and Study Domains

The initial and boundary conditions for ETACLIM and RegCM3 were provided by NCEP/DOE reanalysis II (Kanamitsu et al., 2002). Sea surface temperature was obtained by interpolating the monthly averaged values of the Reynolds et al. (2002). The monthly climatology of air temperature and precipitation of the Climatic Research Unit (CRU) of the University of East Anglia (New et al., 1999) and GPCP (Huffman et al., 2001) data were utilized to verify the RCM results. The chosen regions were the Caribbean, East Europe, Peruvian Andes and U.S. (Figure 1) and the periods were defined as extreme cases of drought and very rainy periods for particular regions as described in the Table 1. The meteorological definition of drought (very rainy period) that will be applied in this paper is that the amount of precipitation received over an extended period of time is significantly less (greater) than the usual expectation for the period.

Table 1 Regions and periods of study.

Caribbean		East Europe		Peruvian Andes		U.S.	
80W, 22.5N		13.48E, 45.38N		70W, 10S		100W, 35N	
Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
June 2004	June 1995	August 2000	July 1999	January 1992	January 1994	June 1988	July 1993

Numerical Experiments

Both models were initiated 15 days before the period defined in the Table 1, but these days in the analysis were discarded for spin-up considerations. The same physical configurations were used in all domains; the ETACLIM and RegCM3 configurations are showed in the Table 2. Different points in x and y axes should be used due to the different grid of the models, B and E, respectively.

The resolution of the both models is 50 km approximately with a Mercator rotated projection. Owing to space limitations we focus mainly on result for precipitation fields.

Table 2 Characteristics and configurations of the models.

Characteristics		ETACLIM	RegCM3
Physics	Cumulus	BMJ	Grell
	Radiation	GFDL	CCM3
	PBL	Mellor-Yamada	Holstag
	LSM	NOAH	BATS
Vertical resolution		38 eta levels	14 sigma levels
Horizontal resolution		47x67	71x54
Dynamics		Hydrostatic	Hydrostatic

RESULTS

Figure 1 and 2 to show the monthly mean precipitations simulated by the ETACLIM and RegCM3 models and the GPCP data for droughts and flooding periods described in the Table 1. The results the both models shows that on Caribbean and US are similar than over Andes and Europe, although over US the RegCM3 performs better than ETACLIM. On the Caribbean region the ETACLIM is drier, if compare to GPCP data. Over the Peruvian Andes and Europe the RegCM3, for this particular configuration, has inferior performance than ETACLIM. However, the models are capable of capturing the extreme events over different regions, using the same configuration for all domains. This shows that it can be used to predict climate anomalies.

SUMMARY AND FUTURE WORK

In this paper are showed preliminary results of transferability experiments over different regions for similar climate regimes (droughts and very rainy periods). Two regional climate models were used, the ETACLIM and RegCM3. The particular configuration of the each model was the same for all regions.

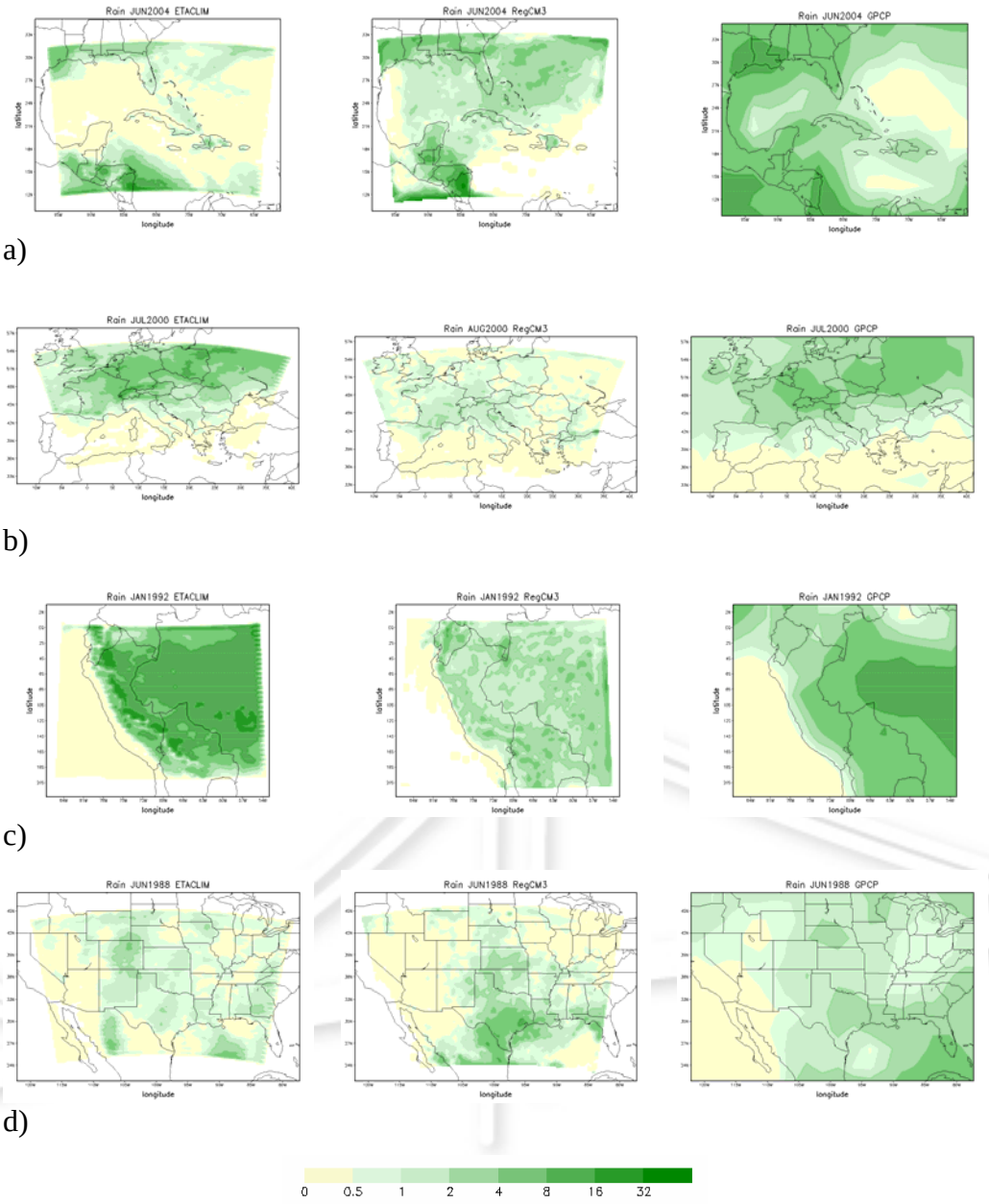

Figure 1 Monthly mean precipitation over different regions for drought cases: a) Caribbean; b) East Europe; c) Peruvian Andes and d) U.S. Left panel ETACLIM simulations, center panel: RegCM3 simulations and right panel GPCP data. Units: mm day^{-1}.

The preliminary analysis shows that the both models are successful in simulating the climate over different regions in extreme events, but with differences. The coupling of the physics parameterizations seems to work better in RegCM3 than in ETACLIM in some regions: Middle latitude and Caribbean than others: Peruvian Andes and Europe. A hypothesis for this is that one particular parameterization (cumulus and/or surface process) might be better coupled in this model.

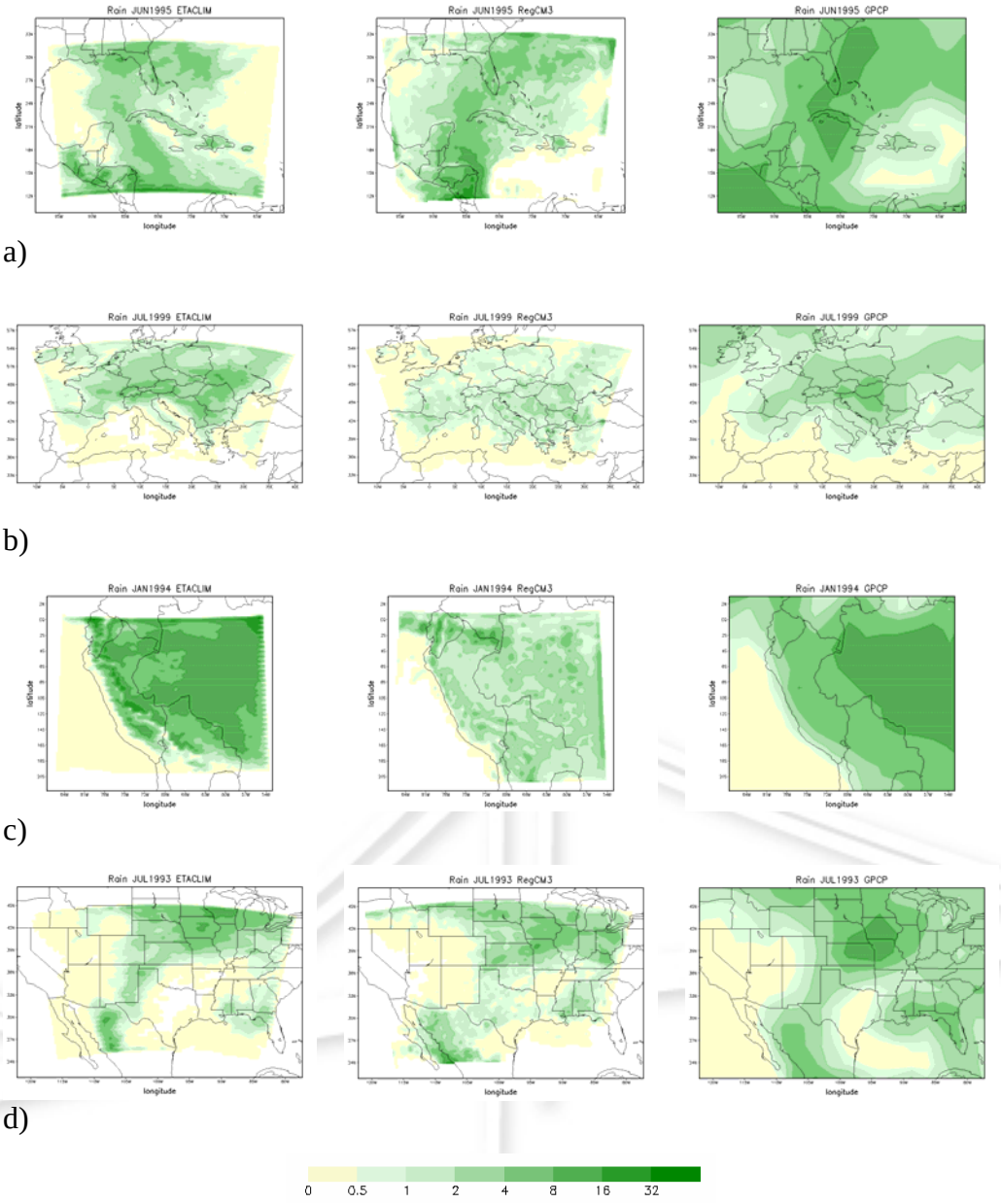

Figure 2 Same as Fig. 1, but for the very rainy cases.

Early tuning experiments over South America showed that the parameters of cumulus parameterizations of RegCM3 are more sensible, e.g. great differences are found between experiments using different parameters. However, for the ETACLIM slight differences are found between experiments when the parameters are modified. The impact of initial conditions of soil moisture should be estimated, due to the limited spin-up time used in these experiments. Runs over other regions as Africa and Asia will be performed in the future. The domain size was other factor that should be taken into account mainly over great continents as South America, Asia and Africa. In this paper this issues were not considered. We have still results of simulations to analyze (diurnal cycle of precipitation, energy and water budget).

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